

**Sertifikaat**

PATENTKANTOOR

REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN HANDEL  
EN NYWERHEID

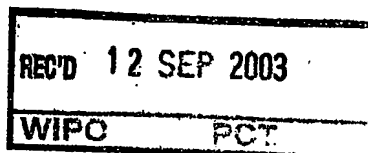


PCT/1303/2186/521831  
**Certificate**

REPUBLIC OF SOUTH AFRICA  
PATENT OFFICE

Rec'd PCT/PTB 21 JAN 2005  
DEPARTMENT OF TRADE AND  
INDUSTRY

Hiermee word gesertifiseer dat  
This is to certify that



the documents attached hereto are true copies of the  
Forms P2, P6, provisional specification and drawings of  
South African Patent Application No. 2002/9237 in the  
name of Sasol Wax (SA) (PTY) LTD

Filed : 13 November 2002  
Entitled : Polymeric Fibre Extrusion

Geteken te  
Signed at

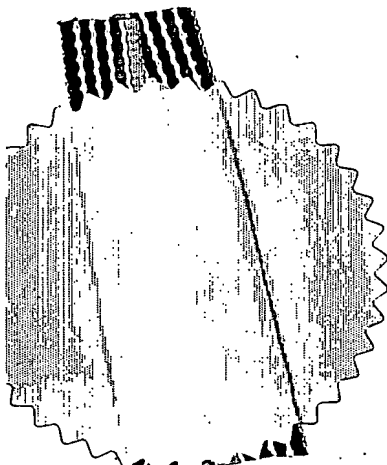
PRETORIA

in die Republiek van Suid-Afrika, hierdie  
In the Republic of South Africa, this

6th

dag van  
day of

August 2003



Registrateur van Patente

**PRIORITY  
DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)

REPUBLIC OF SOUTH AFRICA			REGISTER OF PATENTS			PATENTS ACT, 1978		
OFFICIAL APPLICATION				LODGING DATE: PROVISIONAL			ACCEPTANCE DATE	
21	01	2002/9237		22	13 NOV 2002		47	
INTERNATIONAL CLASSIFICATION				LODGING DATE: COMPLETE			GRANTED DATE	
51				23				
FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)								
71	SCHUMANN SASOL SOUTH AFRICA (PROPRIETARY) LIMITED SASOL WAX (SA) (PTY) LTD 10/3/03							
APPLICANTS SUBSTITUTED:							DATE REGISTERED	
71								
ASSIGNEE(S)								
71							DATE REGISTERED	
FULL NAME(S) OF INVENTOR(S)								
72	1. BENETTI, ALDO 2. FOURIE, JOHAN 3. ZWANE, IVOR MZWANDILE							
PRIORITY CLAIMED			COUNTRY		NUMBER		DATE	
N.B. Use International abbreviation for country (see Schedule 4)			33	NIL	31	NIL	32	NIL
TITLE OF INVENTION								
54	POLYMERIC FIBRE EXTRUSION							
ADDRESS OF APPLICANT(S)/PATENTEE(S)								
1 KLASIE HAVENGA ROAD, SASOLBURG, 1947, FREE STATE, SOUTH AFRICA								
ADDRESS FOR SERVICE						S & F REF		
74	SPOOR & FISHER, SANDTON					PA133791/P		
PATENT OF ADDITION NO.				DATE OF ANY CHANGE				
61								
FRESH APPLICATION BASED ON				DATE OF ANY CHANGE				

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978  
**APPLICATION FOR A PATENT**  
AND ACKNOWLEDGEMENT OF RECEIPT  
(Section 30 (1) - Regulation 22)

REPUBLIC OF SOUTH AFRICA  
VENUE

R 0060.00

The granting of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

OFFICIAL APPLICATION NO.

21	01	2002/9237
----	----	-----------

PA133791/P
------------

FULL NAME(S) OF APPLICANT(S)

71	SCHUMANN SASOL SOUTH AFRICA (PROPRIETARY) LIMITED SASOL WAY (SA) (PTY) LTD
----	---

ADDRESS(ES) OF APPLICANT(S)

1 KLASIE HAVENGA ROAD, SASOLBURG, 1947, FREE STATE, SOUTH AFRICA
--

TITLE OF INVENTION

54	POLYMERIC FIBRE EXTRUSION
----	---------------------------

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. THE EARLIEST PRIORITY CLAIM IS:

COUNTRY: NIL	NUMBER: NIL	DATE: NIL
--------------	-------------	-----------

THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.

21	01	
----	----	--

THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND IS BASED ON APPLICATION NO.

21	01	
----	----	--

THIS APPLICATION IS ACCOMPANIED BY:

- ☒ 1. A single copy of a provisional specification of 6 pages.
- ☐ 2. Drawings of sheets
- ☐ 3. Publication particulars and abstract (Form P.8 in duplicate).
- ☐ 4. A copy of Figure of the drawings (if any) for the abstract.
- ☐ 5. Assignment of invention.
- ☐ 6. Certified priority document.
- ☐ 7. Translation of the priority document.
- ☐ 8. Assignment of priority rights.
- ☐ 9. A copy of the Form P.2 and the specification of S.A. Patent Application No.
- ☐ 10. Declaration and power of attorney on Form P.3.
- ☐ 11. Request for ante-dating on Form P.4.
- ☐ 12. Request for classification on Form P.9.
- ☒ 13. Form P.2 in duplicate.
- ☐ 14. Other.

74 ADDRESS FOR SERVICE: SPOOR &amp; FISHER, SANDTON

Dated: 13 November 2002

*[Signature]*  
SPOOR & FISHER  
PATENT ATTORNEYS FOR THE APPLICANT(S)

REGISTRAR OF PATENTS DESIGNS, TRADE MARKS AND COPYRIGHT
2002 -11- 13
REGISTRAR VAN PATENTE MOEDELLE, HANDELSMERKE EN OUTEURSREG
REGISTRAR OF PATENTS

REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978

## PROVISIONAL SPECIFICATION

(Section 30(1) – Regulation 27)

OFFICIAL APPLICATION NO.

LODGING DATE

21	01	
----	----	--

22	13 NOVEMBER 2002
----	------------------

FULL NAMES OF APPLICANTS

71	SCHUMANN-SASOL-SOUTH-AFRICA-(PROPRIETARY) SASOL WAX (SA) (PTY) LTD
----	---

NAAM VERANDER  
NAME CHANGED  
10.03.03

FULL NAMES OF INVENTORS

72	BENETTI, ALDO FOURIE, JOHAN ZWANE, IVOR MZWANDILE
----	---

TITLE OF INVENTION

54	POLYMERIC FIBRE EXTRUSION
----	---------------------------

### BACKGROUND OF THE INVENTION

THIS invention relates to polymeric fibre extrusion.

Synthetic filaments and fibres are usually produced via an extrusion process whereby the polymer (e.g., polypropylene, polyethylene, polyester, nylon, etc.) is melted and forced through fine holes known as spinnerets. The fibres are then stretched or drawn until the required weight (or denier) is achieved.

The drawing process involves a continuous stretching of the solid polymer fibre or filament at a temperature slightly below its melt temperature and is used to align long polymer molecules in the fibre- or filament drawing direction which gives the fibre- or filament its strength. The degree of stretching (described by the draw ratio) determines the fibre strength (tenacity) and ultimate elongation properties. The production of fine fibres or filaments requires a polymer which:

- (i) has a low enough viscosity in the melt that it can be extruded through the fine spinnerets at a sufficiently high rate without the onset of draw resonance or melt fracture; and,
- (ii) has a high enough molecular weight that the mechanical strength of the fibres or filaments are sufficient to prevent breakages during drawing. Furthermore, the properties of the fibre or filament need to meet the requirements of the final application.

Unfortunately the polymer requirements for good processability do not result in good final properties, and *vice versa*. Processing of low molecular weight polymers results in weak fibres or filaments at best, but low molecular weight are usually not processable at commercially important extrusion outputs due to filament breakages and often result in die build-up and dripping. While better property fibres and filaments are produced using higher molecular weight polymers, this comes at a cost during processing when high torques are required to extrude the more viscous melt. This may be overcome somewhat by processing at higher temperatures, however this results in thermal degradation of both the polymer (which leads to decreased mechanical properties) and additives or adjuvant substances such as pigments mixed with the polymer. The use of high torques leads to high power consumption of the extruder, which also contributes to the cost of fibre or filament production.

### SUMMARY OF THE INVENTION

According to the invention there is provided a method for extruding a polymer, typically for producing polymeric filaments and fibres from a polymer, the method including the steps of:

1. adding a linear low-molecular weight polymer, to the polymer being processed; and
2. extruding the mixture so formed.

The linear low-molecular weight polymer typically has a chain length of C30 to C1000, preferably C80 to C120.

From 0.5% to 25% w/w preferably from 1% to 4% w/w linear low-molecular weight polymer may be added to the polymer to be processed.

The linear low-molecular weight polymer may be melt blended or simply mixed with the polymer to be processed prior to the extrusion step.

The invention also relates to an extruded polymeric product containing from 0.5% to 25% w/w preferably from 1% to 4% w/w linear low-molecular weight polymer having a chain length from C30 to C1000, typically from C80 to C120. Advantageously, the low-molecular weight polymer is a wax produced in the Fischer-Tropsch process

### DESCRIPTION OF EMBODIMENTS

This invention relates to a improved method for the production of polymeric fibres or filaments in an extrusion process. Typical polymers that may be processed are polypropylene (homopolymer and copolymer), polyethylene (low density, linear low density and high density) as well as blends thereof.

According to the invention, a linear low-molecular weight polymer is added to the polymer being processed prior to the extrusion process.

Typical low-molecular weight polymers include linear polymethylene with very little branching (preferably  $<5 \text{ CH}_3/1000\text{C}$ ). Chain lengths of C30 to C1000 are suitable although chain lengths of C80 to C120 are preferred. Particularly suitable linear low-molecular weight polymers are waxes which are produced in the Fischer-Tropsch process.

The amount of low-molecular weight polymer which is added to the polymer to be processed depends on the solubility of the low-molecular weight polymer in the polymer to be processed. Usually the low molecular weight polymer will be added in the amount of between 0.5% to 25% w/w, preferably 1% to 4% w/w.

In one embodiment, a method according to the invention is carried out by mixing a polymer to be processed with a linear low-molecular weight polymer as described above. The mixture is then fed to an extruder which is operated at temperatures of between  $110^\circ\text{C} - 300^\circ\text{C}$ , depending on the polymer run, typically  $110^\circ\text{C} - 200^\circ\text{C}$  for LDPE and LLDPE,  $130^\circ\text{C} - 220^\circ\text{C}$  for HDPE and  $170^\circ\text{C} - 280^\circ\text{C}$  for PP. The actual temperature profile used as well as the melt temperature of the polymer depends on the linear density of the tape being produced, the processing equipment and the converter preferences. The melted polymer is extruded either as a sheet or as tapes or as monofilaments into either a chilled water bath (water temperature typically  $5^\circ\text{C} - 30^\circ\text{C}$ ) or onto a chilled roller. The extruded fibre is then heated through an annealing oven or over a hot-plate, the temperature of which depends on the polymer run, as well as the line speed, but is typically set about  $80^\circ\text{C} - 100^\circ\text{C}$  (LDPE and LLDPE),  $100^\circ\text{C} - 130^\circ\text{C}$  (HDPE) and  $110^\circ\text{C} - 150^\circ\text{C}$  (PP). Draw ratios between 1:2 and 1:12 may be used, although typical ratios of between 1:4 and 1:8 provide the best balance of properties (tenacity and elongation).



The presence of the low molecular weight polymer in the polymer to be processed acts as a viscosity modifier during processing. The use of this viscosity modifier results in the following:

- (i) lower torques than otherwise required to extrude a polymer with the same molecular weight and molecular weight distribution characteristics at the same melt temperature. The polymer therefore experiences less shear during processing and is less degraded resulting in stronger fibres and filaments with a superior balance of properties;
- (ii) lower extruder torque is reflected as lower electrical power requirements. This may be enjoyed as a cost saving or, in the case where the extruder is running at capacity the use of the invention allows for increased outputs becoming possible by using the additional power available from the easier processing to increase the screw speed;
- (iii) the easier processability of polymer with the same molecular weight also means the polymer can be processed at a lower temperature without higher motor torques being necessary. Lower temperatures result in less thermal degradation and are required when temperature sensitive pigments are used; and reduce the levels of smoking or fuming of volatile products or degradation by-products;
- (iv) lower processing temperatures also result in a reduced fibre- or filament-cooling requirement. The rapid cooling (quenching) of the molten fibres extruded from the spinnarets is an important control parameter in the production of fibres and filaments, poor or slow cooling results in a more crystalline fibre or filament which cannot easily be drawn without breaking;
- (v) the reduction of melt viscosity when using the invention described also mean that a higher molecular weight polymer can be processed without higher demands on the extruder motor than when running a lower molecular weight polymer without the addition of the described invention;

- (vi) although there are a number of variables which effect fibre- or filament strength, as a general rule-of-thumb tenacity and elongation are inversely proportional to one another at draw ratios of commercial interest. Obtaining a high tenacity at a low draw ratios will result in tapes with good ultimate-elongation properties. The addition of the described invention acts as a solid-state viscosity modifier at the temperatures used for drawing. This results in easier drawing and higher tenacities are attained at lower draw ratios with a consequence that higher ultimate-elongation properties are achieved;
- (vii) the ability to produce high tenacity fibres- or filaments at lower draw ratios benefits converters with equipment limited in the draw ratios possible. It also allows for power savings during drawing;
- (viii) the addition of the described invention running the same draw ratio will result in higher tenacity and ultimate-elongation fibres or filaments being produced than using the same base polymer under the same process conditions without the addition of the invention up to the point where the fibre or filament is overdrawn; and
- (ix) the addition of the described invention also allows converters to run heavier (higher denier) fibres and filaments at outputs not readily achievable without the addition of the invention.

Dated this 13<sup>TH</sup> day of November 2002.



Spoor & Fisher

Applicants Patent Attorneys